

THE FLYING CRANK GHOST

Please be patient while the images load. They are quite helpful in clarifying the construction of the mechanical components.

NOTE: To see the newer marionette instruction sheet that came with our kit, click [HERE](#).

It includes the new method of 'blueing' the cheesecloth drapery instead of painting, as well as illustrations on how to drape the ghost!



Halloween automata and their creators make strange bedfellows. You may even begin to share your dreams with the odd things you are in the process of creating. They often end up acquiring their own personalities and names. The spectre whose mechanism I am about to describe took for herself the name *Victoria*. She is definitely a character and positively a lady, one who moves with a ghostly grace and mesmerizes onlookers with frightful charm.



She floats in mid-air, wrapped in an ethereal glow, her eyes blazing red and piercing the souls of all who see her. Her arms move smoothly, each in its own natural way, while she slowly hovers, rising and falling as she gestures (the animated image above speaks for itself). Depending on the whim of her builder, she even may speak, her eyes flashing with the words. Would you like to invite to her to inhabit the confines of your beloved haunt? If so, ready your lab and prepare to conjure her forth, for Victoria's mechanism is simplicity itself and the plans for her construction lie below. Don't blame us if she haunts your house indefinitely!

As mentioned in our article, **Halloween - Just Imagine**, we suggest creating a background for haunts and their inhabitants. This involves a



synopsis that imagineers refer to as a *back story*. For a look at Victoria's back story, click [here](#). Press your browser's back button to return to these instructions.

The figure is actually an articulated marionette, which hangs from a motor platform that attaches to your attraction's ceiling. She will require some time to construct - 2 or 3 days - but the rewards you reap will more than repay your efforts. You *will* get complements if you exhibit this stately ghost in your haunt.

The Materials

Read the entire article before shopping. The list below is included to give you an idea of what is to come.

- * 5-7 yards of cheesecloth or similar gauzy material. It should be sturdy enough, however, to stand up to continual movement. Be sure whatever material you choose is not very heavy, or your ghost will not look 'etherial'.
- * A styrofoam wig-form, which will become the head of your figure.
- * One small can of fluorescent blue spray paint, and a can of flat black enamel (to render the mechanical components invisible in darkness). If you have access to an airbrush, water base paints meeting the color requirements will do just fine.
- * A blacklight. It need be no larger than a 12 inch tube, if your anticipated stage location is a darkened haunt. Enclose it in a simple directional reflector, which may utilize aluminum foil. Be careful not to allow the foil to contact any electrical connections on the tube, and consider safety precautions - use no flammable materials in the reflector. It will also be handy to include some sort of shuttering device to direct the UV only where it is wanted. If the black light wanders into the spectator space, it can ruin the effect.



* A Dayton model 2 (left) available at an in Graingers, which ha (U.S.A.) This model and is perfectly suite slow-moving ghost, part costs about \$50 reliability it offers. It list is included with wholesaler - you ma of your workplace, a <http://www.grainger.com> you.)

* Two 4-foot lengths of aluminum L-stock, with 1-inch sides. You will need 1/4 inch, 1 1/2 inch long diameter bolts and eyebolts to assemble the motor platform. You will also need some flat aluminum stock, 1/8 inch thick by 1 inch wide by at least 2 feet long. You will also need a small U-bolt, available as a component of a wire clamp kit (such as Campbell part 767-5117 - a kit intended for 3/16" size wire, shown at right) small enough to encircle the motor's output shaft. It will be used to mount the aluminum stock to the shaft and form a crank, as shown. Hardware stores like *Home Depot* commonly carry these items. These materials will be used to build the motor and animation assembly, which will be described and shown in pictures below.



* Three small, smoothly operating pulleys, and about 25-30 feet of rope of a diameter which will fit them comfortably without snagging between the wheel and housing. These three pullies will support the marionette described herein; but you may need a fourth and fifth pulley if you desire to build a heavier ghost, which will require a counterweight to balance it and take the excess load off the motor (more about this later.)

* Nylon twine (or very small rope) to serve as the lines securing the pulleys to the motor rig.

* Nylon monofilament - or fishing line - about 15-20 feet. This will lead from the thicker ropes required for the pulleys to your marionette, and help keep the *modus operandi* invisible to the audience.

* Find some old coat hangers, which will be used to form the figure's armature beneath the head assembly. Don't use pants hangers with paper sleeves; you will need the single continuous wire variety. Avoid hangers made of thin, easily bent wire.

* Stiff paper to form the hands of the marionette (manilla folder paper is perfect.) Make sure that the paper is thick enough to hold a shape.

* Make an expedition to Radio Shack and acquire two light emitting diodes (L.E.D.'s) Ordinary ones will do in the low lighting used, and the 'high brightness' version would most likely spoil the subtlety of the effect. You will need a trim pot, preferably with a 100k ohm value. If you don't know what these are, ask the salesperson. They usually come in multiple packages, but are quite cheap. The trim pot will be used to 'ballast' the L.E.D. - that is, it will be set to prevent too much current from passing through the pair, which will be the ghost's eyes. You will also need some single strand electrical wire. If you decide to use the voice option, you will need 2 70v. speaker system audio transformers, also available from Radio Shack. These will probably cost you about 8-10 dollars each. (If you are non-technical, don't panic yet! See below for more details on this aspect of the project. Read all the information before going shopping.)

* Water-based craft glue, large bottle. *Elmer's Glue* will do, although *Tacky* (available at most craft stores) is my personal favorite.

* Main tools:

Pliers, regular and needle-nose

Wire cutters

Scissors

Soldering iron and solder

Drill and bits

Vise

Patience, devotion, and loving care

The Ghost Marionette

Note: As mentioned earlier, we offer simple instructions for a cartoony children's version of the FCG marionette. The instructions can be viewed by clicking [here](#), and you'll find a link at the bottom of the page that will return you to this very spot when you are done. *Even if you aren't interested in the comic marionette, be sure to visit the page for other ideas involving the FCG motor platform, which will be described below, in Part 2.*

The Head:

At this point, consider the expression your spectre will wear. Will she smile, will she frown... or simply be enigmatic? Consider your attraction, and why she is in it. Is she the

owner of the haunt? Is she imprisoned there by force? Is she the hostess? Think of what she might say to your guests... be creative. She is potentially pure drama!

Begin with the Styrofoam wig stand, and locate the position of the eyes. If the form has a flat front, use your best guess. Hollow out the eye sockets and mouth as if you were making a skull. The mouth can be an open oval, as if the figure were speaking; or, if your wig form has a mouth, you can decide to leave this as it is - it all depends upon the effect you are after. Press the Styrofoam inward to form the required cavities. Don't rush, and use your creativity. You may wish to sculpt more detail into the face... jaw lines, narrow chin... whatever you can imagine.

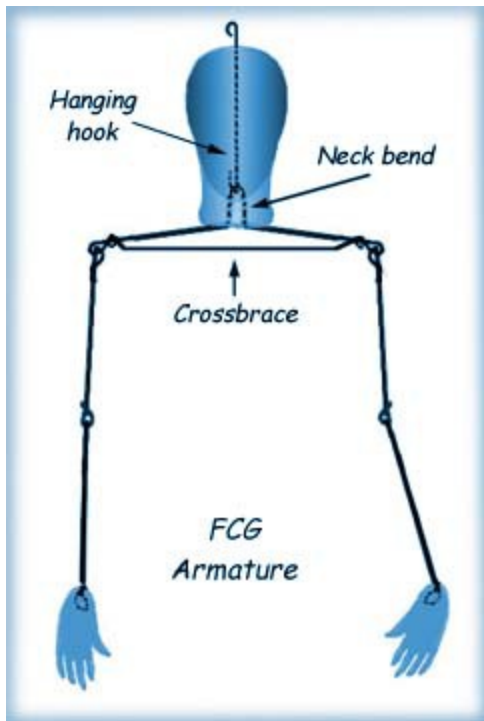
If the wig stand has a wide, extended base, lop it off. The neck must taper, and it will attach to a hooded drapery which becomes its 'body.' If the entire ghost is draped in the same fabric, as it should be, there will be a feel of continuous texture.

If you are a sculptor, modeling paste may be used to add features. Have fun with this part, and give the face character. Take your time. This is the heart and soul of your spectre, and the part that communicates to your guests.

You will next need to cover the head with cheesecloth, or the material of your choice. I recommend that the same material be used throughout the figure. Make a thinned paste from the glue, and soak a square of the fabric large enough to cover the form. Cut this piece, and trial-fit it before soaking it in the glue. Apply the fabric, pressing it into the eye and mouth cavities, smoothing it around the facial features, and gathering the excess behind the head where it will not be seen. Do not leave wrinkles of cloth on the face, unless that is the effect you desire. Allow to dry, then trim off the excess if necessary.

The Armature:

You will be cutting coat hanger wire in this step. *When working with tools on this project, be careful - you are out to build a ghost, but don't make one of yourself in the process!* The typical pair of adjustable pliers has a cutter at the back of its jaws, and is perfect for this purpose.



An *armature*, for those who aren't familiar with the term, is the skeleton of an animatronic figure. *Examine the illustration at left, which will make the following instructions clear.* You need to make a set of shoulders for your ghost, and they will be approximately life-sized. (We find that making the shoulders 3 to 4 inches narrower than life-size enhances the willowy nature of the ghost.) Take a single coat hanger, and untwist the hanger hook so that you have one single piece of wire. If you've ever used a coat hanger to pop a car door lock in an emergency, you know what is being described. Bend the *center* of this wire into a U-shaped segment about 6 inches long. You should end up with an equal amount of wire on each side of the 'U'. The narrow 'U' is to be inserted into the bottom of the neck of the head-form, and the wire extending outward from it will form the figure's shoulders.

Make a long hook out of a piece of wire about two feet long. The hook section should be a couple of inches deep. Make a socket in the bottom of the wig form about 4 inches deep, then capture the U-section of the shoulder wire into your hook. Insert the straight segment of the hook member into the hole in the bottom of the wig form and carefully press it through until it emerges from the top of the head. Next, slowly pull the U-section of the hanger piece into the hole until the shoulders are in place below the neck. The part of the hook member coming out of the top of the head may now be formed into a hanging hook. Cut off the excess wire you don't need before forming this second hook.

Next, take a pair of pliers and bend the end of each 'shoulder' into a round loop. Using your own arms as a model for length, cut up four more coat hanger pieces to represent the lower and upper halves of both arms. Join the arm segments at the elbows with interlocking loops like the ones at the shoulders, then similarly attach the upper arms to the shoulders below the head. Make sure that the arms can swing freely and not lock up in normal movement. You will need to experiment with this. Note that in the diagram above, we've installed a cross brace, which consists of another section of wire twisted around the shoulder form.

Hands may be cut from cardboard, or manilla folde paper. Wrap the paper forms in the same gauzy fabric (soaked in the glue mixture) with which you cover the head, and leave

it white for the time being. Simply attach the hands to the 'wrists' of the arms by looping the coat hanger wire through punched holes, or by using glue, to a closed loop of coat hanger. Adjust the wrist positions by bending the wire appropriately. Long, slender fingers work best, and they can be bent into gesturing positions as desired.

This is all the armature you will need. The rest of the ghost consists of flowing fabric draped around the head and over the shoulders and arms. Basically, it forms a shroud (or hair, depending upon how you wish to present it.)

The Shroud:

Here is the place for more artistic calls on your part. The hood could be an expansive cowl, or a tight-fitting wrap.

At this point, attach a string (thin nylon rope) *securely* to the hook on top of the head and at each wrist. Find a convenient place to hang the head-arm assembly while you drape the fabric over it.

Using a single piece of fabric, form a hooded cloak over the head form. Drape 'sleeves' around the armature to the wrists, and allow it to trail around the figure. It should also be gathered and glued around the neck, as well, to cover the base of the wig form. For the present, you'll have to let the hood skirt around the hanging string on the head. After you have decided on the drapery, you will punch a hole in the hood so that the hanging hook can protrude through it. It is, of course, possible to construct the shroud in separate sections, leaving the hood until last to uncomplicate matters. If you choose to do this, be sure that the garment looks as continuous as possible. It should flow, and not be too 'bunched' in places.

This is another place where your creativity should be given full measure, for there are many ways to shape the shroud. Once again, take your time, and experiment before cutting the fabric to its final dimensions.

Beneath the neck, it does not matter if the shroud begins to open up a little, but it is important to cover the neck line itself. At the bottom of the shroud, using a measurement equal to the height you wish the spectre to have, use a scissors to shred the trailing edges into tatters, in a ghostly fashion. Remember that this will look entirely different under black light after being painted.

Your ghost will not look very interesting in regular light, so don't despair if it seems disappointing at this stage. You will end up making more adjustments later, with the figure bathed in UV and floating from its rig. We will cover installing the eyes as we discuss the the animation and painting in the sections to come.

Preliminary Testing:

Remember that the ghost is a marionette, and must be able to move freely. Try flying the completely draped puppet by hand from a suitable ladder. The arms should move readily in all directions, and not hang in any position. Hidden weaknesses in the armature's linkages will immediately become apparent in this test. If there are positions where the shoulders or elbows catch or lock, adjust the placement of the joints by bending the wire. Be sure that the loops are tightly closed so that the closures do not unhook. When the ghost is being driven by its flying rig, it may assume a number of unexpected positions, and thus smooth operation at this point is imperative. Also, make sure that the figure looks as 'natural' as possible, and play with the shroud and draperies until you are satisfied with them.

At the left is a picture of the completed motor platform, intended to give you an advance look at what you will be constructing. It folds up into a relatively small unit for storage, or it can be easily disassembled if desired. This is the piece that makes it all happen. The mechanism is really fairly simple, and if used with the ghost marionette described in the previous section, should not need a counterweight.

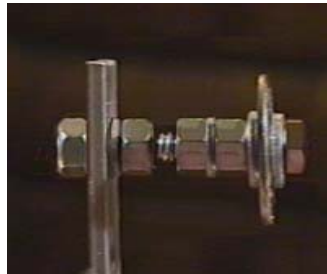
The Crank:

The arm of the crank, as mentioned in part one, is a piece of flat aluminum stock, 1 inch wide. The best length for the marionette described above is about 10-12 inches, and the pivot will attach at about 8 inches out from the motor shaft for best results. The ghost and its arms will rise and fall about twice the length of this arm. Experimentation is recommended, and you can always tap an extra hole in the crank for the pivot assembly closer to the motor, if it becomes necessary to restrict movement.

For attachment to the motor shaft, you will need to drill two holes in the crank arm, spaced to accept both legs of your small U-bolt. It is important to make sure that when the bolt is attached to the motor shaft, the aluminum does not drag against the platform members. The clamp attaches as shown at right.

Note that the aluminum stock is twisted 90 degrees so that the wide dimension of the end holding the pivot assembly is parallel to the ground. Use a vise and Vise Grip pliers to do this. You will find that the bar bends relatively easily. *A picture of the completed crank is shown on the first page of these instructions.*





The pivot at the outer end of the crank, to which the control lines attach, consists of nothing more than a bolt passing through the bar through a hole, with a wide fender washer on each side so as to spin freely, using the bolt as an axle. The fender washer has three holes drilled with equal spacing around its perimeter, forming the attachment points for the control lines to the marionette's head and arms. The part sequence from left to right: Nut...fender washer...nut...lock washer...nut...flat washer...disc with three holes...washer...flat washer...head of bolt. This assembly can be moved to the various holes you may have drilled in the crank arm to adjust the extremities of the marionette's movement.

The image at right shows the holes drilled into the fender washer for attachment of the marionette control lines. Be sure you adjust the nuts so that the fender washer can spin freely but not wobble. Be sure to oil the pivot with a light oil, such as 3-In-1. Admittedly, this is hardly an industrial part, but it moves slowly and will work for many seasons before needing replacement. It is very inexpensive, and you can always build a spare to keep on hand.



The Frame:

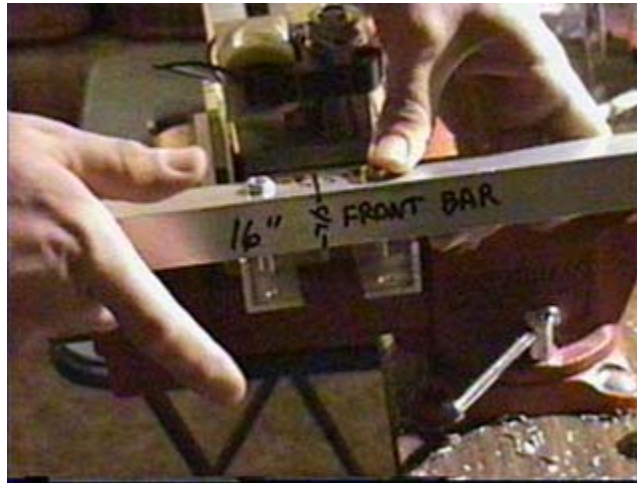
The structure of the motor platform is constructed from the 1-inch angled aluminum stock mentioned previously. The finished platform is quite rigid, and can handle a substantial amount of weight. The two 4-foot sections of this stock should be cut up as follows: *Cut one 20-inch section from each bar. Cut 2 14-inch lengths from the remains of the first bar, and a 16-inch and 12-inch section from the remains of the second. The 'leftover segments' are shown at left, minus the two 20-inch sections that will form the motor mount.*

The motor mounts, as shown at left, to the two 20-inch parts. The 16-inch front member and 12-inch rear member are shown as they will be attached, and this process will be described below. Leave a 3-inch recess between the front of the frame and the gearbox of the motor. The Dayton motor accepts 10/32 machine screws for mounting, and you will need 4 of these. Once the rig is finished, the motor may easily be removed for servicing, if necessary. *(Our video explains in detail where to drill the mounting holes, but it is not difficult to determine this clearance for yourself.)*



The attachment of the front and rear bars is accomplished as shown, with 1/4 inch bolts. Note that there are a pair of 'limit nuts' positioned as shown in the photo to keep the stock from bending when the attachment nuts are tightened. Position these just at the lower edge of the crossmembers, both front and back. Use lock washers to fasten the crossmembers securely. When both crossmembers are attached, the frame becomes quite rigid. *(The video describes in detail where the holes should be drilled in the motor mount members, but it should not hard for the mechanically savvy builder to deduce this from the pictures at left*

and below.)

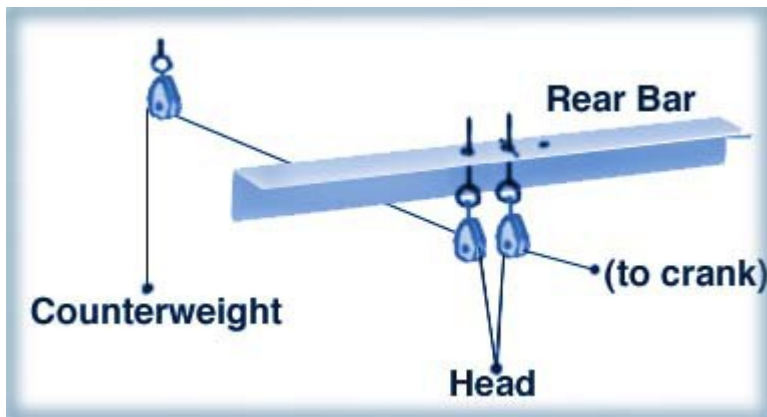


The arms shown being attached to the front crossmember are intended as mounting surfaces for the pulleys required to control the arms of the marionette. The arms can be pivoted to adjust the positions of the arms of the marionette, and will control how the arms of the ghost move when it is flying. Use 1/4 inch eyebolts, with the eyes positioned upward, to attach the arms to the motor platform. The eyes serve as the front hanging mounts for the platform.



Use a lock washer between the crossmember and the arm to keep the arm from moving under load. Make sure the mounting nut on each arm is tightened securely.

The arm pulleys attach to eyebolts mounted at the ends of the arms as shown, using nylon twine or ty-wraps (which make it much easier). This allows the pulleys to twist as the crank changes position. The control lines for the marionette's arms lead through the pulleys to the crank pivot. The pulley wheels should be reasonably close to the plane of the pivot when the lines are under tension. This is somewhat automatic, because the pulley will swing toward the pivot when under load. *You must make sure that the lines and pulleys do not snag on the crank when it is in operation. Adjust the horizontal angle of the crank on the motor shaft to assure this. In other words, don't let the crank's pivot end hang down too far towards the floor.*



The mounting eye for the pulley supporting the marionette's head attaches to the center of the rear crossmember. We use an eyebolt with a 4-inch long shaft, and locate the eye high below the frame, where the head pulley can be attached. The top of this long bolt - extending above the frame - is fitted with a fender washer (like the one used for the crank pivot) drilled with a single hole. This is used for hanging the back of the frame. The diagram shows how to add the additional hardware for a counterweight, should you decide to fly a heavy marionette. The counterweight should be a bit lighter than your weighty ghost. *(The marionette described in these instructions should not*

require a counterweight.)

The image at right shows the motor platform with the control lines installed. The thick lines should be blackened with a permanent felt tip marker to keep them 'invisible.' If you want to keep the lines to your marionette thin, cut the lines such that they hang just below the pulley when the crank pivot is farthest the pulley for each line. Attach lengths of nylon monofilament (thin fishing line, or whatever you wish) to the control lines at this point and run them to the marionette's attachment points. Hang the motor platform and test your arrangement with the motor running. *The motor's electrical lines are nonpolar, and can be attached to lamp cord, although we recommend a grounded (three-prong) cord set. The ground lead (usually green) of the cord set should be securely attached to the motor platform.*



What happens when it runs?

The movement of the marionette, when suspended from this slow-moving apparatus, is amazingly natural-looking. The body of the ghost slowly rises and falls, and the arms gesture independently of that movement. You really have to see the effect to believe that it can be achieved with such a simple rig. Experiment by moving the pivoting arms to different positions. What this does it to change the phase relationships (relative timing) of the moving parts. You will notice that the marionette tends to turn slightly to left and right as she flies. This adds to the drama, as if she were addressing a group of guests. If you find that the movement of the ghost's arms is shaky, add some weight beneath the hands (such as a fishing sinker.)

Important NOTE: You can either paint your ghost as described in the following instructions, **or take the simple route of washing your cheesecloth (or chosen fabric) in ordinary laundry detergent before draping.** This dyes the cloth with **blueing**, which is added to virtually every laundry detergent sold today, and glows blue under black light. You'll need to drape the styrofoam head with fabric, too, if you use this method, but it's **easy!** Once again, see our [instruction sheet](#) for details, then press your back button to return here.

Really, the best approach to painting a fabric prop that will be used in a blacklight setting is to paint it in a blacklight-illuminated setting. Before you begin draping your ghost, when visiting the fabric store, take along a small portable blacklight and expose a bit of the fabrics you sample to UV. You may be surprised at the results. If you want to start with a dark surface, be sure your fabric is not impregnated with 'blueing' (a fluorescent dye commonly found in laundry detergents) or a fluorescent factory dye.

With this in mind, and with your draped figure ready to paint in a blacklit environ, consider technique. Don't just saturate the surface with the chosen color until it is submerged in paint! If you want subtlety, and you are starting with a non-fluorescent surface, use a very light mist, by spraying from a distance when using aerosol paint, or by using an airbrush with a very low paint-to-air mixture. Watch under the blacklight as the effect builds up on the figure or object. Stop when you achieve a mysterious glow. Remember that fluorescent paint is a visible light source, just like a light bulb. If there is too much UV paint, it will produce too much visible light, and may reveal details that you wish to keep hidden, killing the atmosphere you have worked hard to create.

When painting with fluorescent paints, remember that adding color is not the same as with ordinary non-fluorescent colors. When you add fluorescent red, blue, and green in the right mixture, you don't get a murky brown - you get *white*. Yes, like a color TV, which uses red, blue and green phosphor dots to get colors, you are *painting with light* (not mixing colors.) In short, take a scrap of material and experiment. You will be surprised at what may be done with light mists of fluorescent paint.

I suggest that you use fluorescent blue on the spectre in this example. Green, or yellow (which tends to look slightly green as a fluorescent dye) can produce an equally attractive ghost. This is your call. You can also use flat black to produce the effect of shadows under blacklight. It can help correct places that are too bright. Be sparing, take your time, and experiment on scraps before painting the ghost.

NOTE: If you cannot locate fluorescent blue spray paint, wash your cheesecloth in detergent containing blueing (most brands do) before covering your marionette. This will most likely do the job for you. If the result is too bright, reduce the lighting level by moving the blacklight fixture farther from your ghost.

When you finish with the painting, you will install the L.E.D. eyes, as mentioned below. You may wish to paint the interior of the eye sockets flat black so that the the eyes seem to float within them like mysterious points of fire. The effect is really nice, and you will agree when you see it!

The Eyes Have It

NOTE: Our friend **Jim Kadel** at **Haunt Master Products, Inc** (<http://www.hauntmasterproducts.com>) has a wonderful LED-eye product line manufactured specifically for props like our FCG. They are available in several varieties and colors - including the NEW ultra-bright blue, which is amazing to see - and can flash

or strobe, or work with audio for the 'talking' version of our ghost. If you'd rather leave the wiring to someone else, go see Jim! I get mine from him as well - time is money!. :-)

Additionally, these bright LED's are intense enough to use as mini-floodlights in the dim environs of a haunt - just shroud or put tiny reflectors around them. In my experiments with a 1/3 scale FCG, they were adequate to light the ghost - an alternative to blacklight - and they can flash or pulse as well. Other uses are limited only by your imagination. He also offers a packaged version of our talking eyes, which is much easier to set up than building our version from scratch. Be sure to let Jim know you want ultra-brights, in whatever color. They're a wow.

Glowing red eyes provide a vividly contrasting element to the rest of your marionette. They will immediately draw your guests' attention, and heighten the drama provided by the animatronic. If you are uncomfortable with wiring, paint two round beads with fluorescent orange, and glue them into the eye sockets of the marionette after you paint it as described below.

There are two ways to go with this part of the project. You can have steady-state glowing eyes in your ghost, which are always on; or you can have eyes that flash with a pre-recorded (or even live, through an offstage microphone) speech.

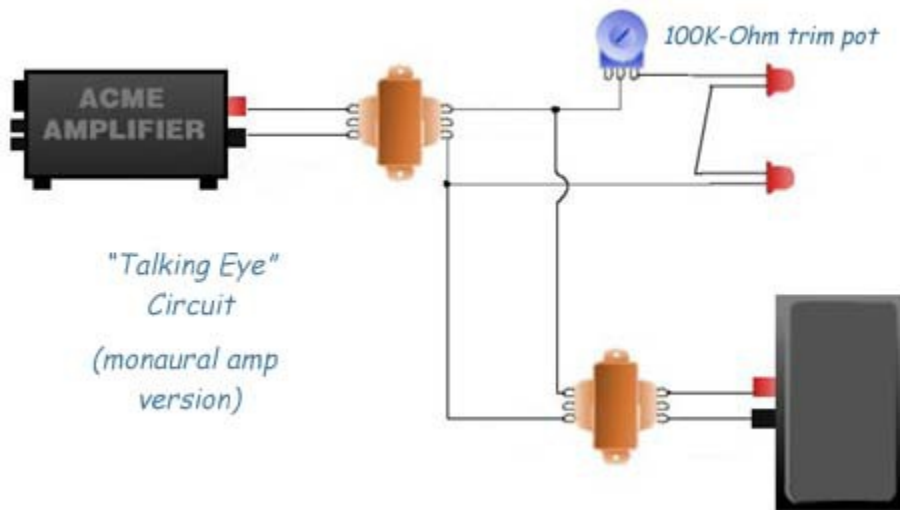
Both approaches require that you install L.E.D.'s in both of the figure's eye sockets. Carefully solder a long (6' or longer) wire lead to the short lead on one L.E.D. and to the long lead of the other. Now, solder a 1.5 foot wire to the remaining leads on each L.E.D. With electrical tape or shrink tube, completely cover the exposed soldered leads on each L.E.D. to prevent shorting.

Note: The above step is important. You need to connect the short lead (usually the cathode) of one L.E.D. to the long lead (usually the anode) of the other, using the wires that emerge from behind the head. For those who will use batteries and a trim pot (or resistor) for 'constant on' eyes, the positive terminal of the battery must feed the long lead (anode) of the L.E.D. You must know which wire is which! If the eyes don't light, reverse the polarity. *The formula for deciding the value of the ballast resistor for a given D.C. voltage supply is given below in the Appendix ("L.E.D. Math for Imagineers"), with examples.*

Using a long ice-pick or knitting needle, punch holes through the head assembly from the eye sockets to the back. Next, finish the painting of the figure, as described below, before inserting the L.E.D. assemblies into the eye sockets. When you have finished painting, and the figure is completely dry, attach the back ends of your leads near the point of the knitting needle (or of a long piece of stiff coat-hanger wire) using electrical tape. Make sure that you tape the wires to the chosen guide tightly, so that the needle or wire does not hang on the fabric while going through. Use this assembly to pull the wires through the holes in the eye sockets so that the leads exit the back of the head. Be careful not to damage the L.E.D.'s, the wires, or the solder connections while doing this. Remove the electrical tape from the guide, and extract it, being careful to hold the wires so they do

not pull back out with the guide. After the guide has been removed, pull carefully on the electrical leads that emerge from the back of the head until the L.E.D.'s rest in the bottoms of the eye sockets.

Now, make the electrical connection between the short lead from one eye to the long lead of the other eye (connect the two short wires right near the back of the head. You will end up with only 2 long wires trailing to the power supply or amp driver system (for the voice version.) Keep in mind which wire is which at all times, if you plan to use the non-voice D.C. version.



Setting Up the Talking Version:

The recommended circuit for the talking FCG is shown at left. With the L.E.D. hookup completed, play a tape through the amplification system of whatever the ghost is to say. Adjust the trim pot so that the eyes flash on the words: start with the eyes dark, and slowly 'turn up the volume' of the ballast potentiometer until the eyes just begin to flicker. Do this with the system volume set to the level you

expect it to run at during the operation of your attraction, and all should go well. I have suggested a potentiometer value that will most likely handle a wide range of settings on the amplifier, from a whisper to a loud scream.

If the eyes don't light, check the continuity of the wiring, check to see if your solder connections are still holding, and be sure that you aren't using a bad (open or blown) L.E.D. in one or both eyes. It may be necessary to 'match' pairs of L.E.D.'s if one of the pair lights dimly (or not at all.) This is matter for experimentation, and it is a good idea to buy a bulk pack of L.E.D.'s.

Also, note that the above circuit introduces a crude rectifier into the A.C. audio circuit, and will thus introduce a slight amount of distortion. If you find this objectionable, use a stereo amplifier and separate the functions of the eyes and speaker. Use a 'Y' connector to feed the voice track to both channels of the amp. This requires only one transformer on the output of the 'eye channel.' Connect a speaker directly to the 'speech channel'.

Preparation for Public Operation

Hang the motor platform in your haunt, or in a location suitable for testing. Be sure the marionette has room to move freely. Run-test your spectre. Make sure the pulleys don't hang, and that the armature works without snagging. Run your voice setup (or constant-on eyes) with the figure in motion, and be sure your wiring is robust. Allow it to operate for a few hours, *but be sure to supervise this test!* If you use a battery for the figure's eyes, be sure to disconnect it at the end of the evening when you shut down your haunt.

Observe Safety Precautions! Don't locate the hot part of the motor drive within a foot of anything flammable. There will be a small amount of rising heat from the motor sitting atop the gearbox. Avoid using paper and draperies above the mechanism! Although the

Dayton motor doesn't get hot enough to ignite any regular materials I know of in normal operation, there is no point in taking silly risks. *Turn off all power when you shut down.* Check the figure continually throughout the night for malfunctions (hang-ups) that might cause overheating of the mechanism.

Another important issue - *don't point blacklight sources into customers' eyes. This is one of our pet peeves, here at Phantasmechanics: "It's a haunt, not a tanning booth!"* Flooding public areas with blacklight is unsubtle, unnecessary - and your guests' clothes may fluoresce so brightly that your staging is ruined! Unlike white light, blacklight does not warn the iris of the human eye to contract normally, and may cause the person to have the effect of a temporary loss of visual acuity, although minor. It can be like the effect of staring into a car's headlight if the blacklight source is strong enough. Even though short exposure to long wave UV (blacklight) is harmless, be kind to your customers!

Locate your ghost where it cannot be mangled by the grasp of a passerby. If you spend a lot of time on a figure, don't subject it to possible abuse.

Finally, enjoy your creation! Spend time looking at your actress in action. Play with the rig, and make little adjustments until she is playing to your audience the way that you - the director - desire.

APPENDIX

For those of you wishing to use L.E.D.'s in any Halloween project, the following information will be invaluable. Walls of 'bat' eyes and many other such effects are possible with these little wonders, which commonly outlast miniature light bulbs many times over. If you've never played with them, here's your chance to experiment.

L.E.D. Math for Imagineers

$$R \text{ (ballast)} = V \text{ (power supply)} - V \text{ (L.E.D.'s)} / 15 \times 10^{-3} \text{ (or .015)}$$

V (L.E.D.'s) values

(Multiply these values times the number of L.E.D.'s you use in series.)

Red 1.8V
Yellow 2.0V
Green 2.2V
Blue 3.4V

(Good luck finding blue ones, but they look great!)

EXAMPLES:

For 2 Red L.E.D.'s on a 12V supply, use a 560 Ohm resistor

[or: 1.8×2 in series = 3.6 V of Red L.E.D.'s, so...
(12-3.6) / .015 = 560 Ohm or 560 Ohm ballast required]

For 2 Red L.E.D.'s on a 9V supply, use a 360 Ohm resistor For 2 Red L.E.D.'s on a 6V supply, use a 160 Ohm resistor

2 Red L.E.D.'s on a 3V supply need no ballast - it will probably work, despite the predictions of the formula, but it will eat your battery alive. In other words, you should use at least 6 volts or higher to be practical.

NOTES: The LONG lead on an L.E.D. is the ANODE, which expects to see the positive (+) terminal of the D.C. power supply or battery. As mentioned above, the anode of one L.E.D. must be connected to the cathode of the other for the pair to work. L.E.D.'s are, as their name implies, diodes, and thus they will only pass electrical current in one direction. *DO NOT connect L.E.D.'s in parallel.*